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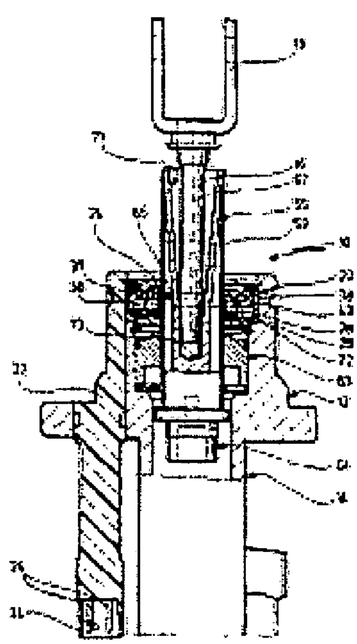
(54) Sensor Device

(57) A sensor device for producing an electric control signal as a function of the relative position of two parts that can be displaced relative to each other, particularly two motor vehicle components, which device comprises at least one magnet for producing a magnetic field and at least one magnetic field-sensitive sensor, which provides an electric control signal as a function of the strength of the magnetic field strength acting upon it, characterized in that the magnet (43) and the sensor (36, 37, 38) are held in a stationary manner relative to each other and that the sensor device (10) comprises a magnetically conductive control member (55), which is held displaceably in relation to the magnet (43) and the sensor (36, 37, 38) for the purpose of influencing the magnetic field acting upon the sensor (36, 37, 38) as a function of the relative position of the control member (55).



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Sensor Device

The invention relates to a sensor device for producing an electric control signals, which is dependent upon the relative position of two parts that can be displaced relative to each other, particularly two motor vehicle components, which device comprises at least one magnet for producing a magnetic field and at least one magnetic field sensitive sensor, which provides an electric control signal as a function of the strength of the magnetic field acting upon it.

Such sensor devices are used in particular as rotation angle sensors, which are used to capture for example the incline of a vehicle undercarriage relative to the chassis. A rotation angle sensor of this kind is disclosed for example in DE 44 13 496 C1. The magnet here is configured as a ring magnet and is held rotatably, while the sensor is fastened in a stationary manner in the housing of the angle sensor.

Linear sensors having a corresponding design are also known, in which a magnet is held displaceably in relation to a Hall sensor. The Hall sensor can detect the relative position of the magnet.

The configuration of the magnetic field is subject to high linearity demands in conventional sensor devices, which limits the effective lift of the sensor, i.e. the displacement or rotation range of the parts displaceable in relation to each other that can be detected by the sensor is limited. Additionally, the mounting of the movable magnet is subject to high demands.

It is the object of the present invention to further develop a sensor device of the type mentioned above such that it allows the detection of a larger range of movements of the parts displaceable relative to each other and a decrease in the demands placed on magnets that are used.

This object is achieved with a sensor device of this kind according to the invention in that the magnet and the sensor are held in a stationary manner relative to each other and that the sensor device comprises a magnetically conductive control member, which is held displaceably in relation to the magnet and the sensor for the purpose of influencing the magnetic field acting upon the sensor as a function of the relative position of the control member.

It is provided according to the invention to hold the magnet and the sensor non-displaceably relative to each other, while the control member is disposed so that it can

move. The control member is configured to be magnetically conductive and is disposed adjacent to the sensor such that it influences the magnetic field strength prevailing at the site of the sensor, wherein the level of influence depends upon the position of the control member relative to the sensor. The relative position of the control member can therefore be reliably detected. The magnetically conductive control member can be made at least partially of an iron material for example, particularly of a constructional steel.

No particularly linearity demands are placed on the magnet used according to the invention; the only requirement is that a magnetic field is generated, which can be influenced by the control member.

The control member can be fastened to one of the two parts displaceable relative to each other. It may be provided for example to capture the position of a piston or of a piston rod relative to a cylinder of a piston/cylinder assembly by means of the sensor device. Piston/cylinder assemblies of this kind are used in motor vehicles, for example. A magnetically conductive piston rod, for example, can be used as the control member, which is therefore configured to be part of the sensor device and is mounted displaceably, while the sensor and the magnet are held adjacent to the piston rod in a stationary manner, for example on the corresponding cylinder. In such a configuration, the sensor device forms a linear sensor, which allows a displacement of the control

member relative to the magnet and the sensor to be detected. Alternatively it may be provided to use the sensor device as a rotation angle sensor. For this it is only necessary to configure the control member such that the magnetic field present on the sensor can be influenced by rotating the control member relative to the sensor.

It may be provided that the control member can be positioned in series with the sensor in relation to the magnetic field lines originating from the magnet. In a configuration of this type, the magnet, the control member and the sensor are part of a magnetic circuit, wherein the magnetic field strength present at the site of the sensor can be influenced by moving the control member.

In a particularly preferred embodiment it is provided that the control member can be positioned parallel to the sensor in relation to the magnetic field lines originating from the magnet. Such a configuration makes it possible, for example, to vary the distance between the control member and the sensor by moving the control member – preferably substantially perpendicularly to the plane defined by the magnetic field lines passing through the sensor. The smaller the distance, the greater the extent at which the magnetic field lines are directed across the control member in the area of the sensor and thus are guided past the sensor, thus lowering the magnetic field strength present at the site of the sensor. In doing so, the control member can perform a rotatory, a translatory or also a combined rotatory-translatory movement.

It is particularly advantageous if the control member abuts a gap – preferably an air gap – permeated by magnetic field lines, the width of which gap can be varied by the movement of the control member. In doing so, the gap forms a magnetic resistance, the strength of which is defined by the width of the gap and can be influenced by varying the gap width. The wider the gap width, the lower the magnetic resistance of the gap and the stronger the influence of the control member on the magnetic field present at the site of the sensor. The respective gap width is dependent upon the position of the control member. Consequently, the sensor device enables an absolute reading of the position of the control member relative to the sensor, since prior to that a calibration curve was determined for the sensor device by means of variation of the gap width. The sensor can reliably detect the absolute position of the control member based on the existing gap width.

It may be provided to configure the gap width in a continuously variable manner. This means that any movement of the control member results in a continuous adjustment of the control signal provided by the sensor.

Alternatively it may be provided that the gap width can be varied erratically by movements of the control member. This offers the possibility of generating an erratically

changing control signal, so that the sensor device can be used for example as a switch, which changes its state when the control member has assumed a predefined position.

In a particularly preferred embodiment of the invention it is provided that the course of the control signal corresponding to the movement of the control member can be defined by the design of the surface of the control member. As explained above, it may be provided, for example, that the control member abuts a gap permeated by magnetic field lines, wherein the gap width can be varied as a function of the movement of the control member. Depending on the shape of the surface of the control member, this way a continuous or abrupt change in the gap width can be achieved. The control member can be configured, for example, as a displaceable toothed rack, so that any displacement of the control member results substantially in an instantaneous variation of the gap width, while a saw-tooth shaped surface configuration of the control member results in a corresponding saw-tooth like variation of the gap width. The course of the gap width as a function of the movement of the control member in turn results in a corresponding change of the magnetic field present at the site of the sensor, thus causing a corresponding change to the control signal provided by the sensor.

It is particularly advantageous if for the purpose of bundling the magnetic field the sensor device comprises a magnetically conductive yoke, which is disposed adjacent to the magnet and defines an open space in which at least one sensor is disposed. The

magnetic field lines originating from the magnet are reliably bundled with the help of the yoke and can be supplied to the sensor and the control member in a targeted manner, so that the sensor device produces practically no interfering magnetic field, which could result in interference with electrical control devices that may be disposed for example adjacent to the sensor device. Using the yoke moreover offers the advantage that the sensor device exhibits only little sensitivity towards exterior interfering fields, because the magnet, the yoke, the sensor and the control member create a closed magnetic circuit, which can only be influenced significantly by very strong exterior magnetic fields.

The magnet can be configured as a horse shoe, for example, wherein the yoke connects the two poles of the magnet directly to each other and for one produces an open space for positioning at least one sensor and secondly produces a gap, preferably parallel to the sensor in relation to the magnetic field lines permeating the yoke, which gap is used to position the control member.

In a particularly preferred embodiment it is provided that the yoke forms a support, in which the magnet is positioned. Particularly with such a yoke configuration, a cost-effective bar magnet can be used, which allows the manufacturing costs of the sensor device to be lowered.

The yoke is preferably configured in a ring shape, particularly in a circular fashion, and the support for the magnet and the open space for at least one sensor are diametrically opposed.

The yoke preferably comprises two yoke arcs configured as semi circles, which on their ends receive between them on one hand the magnet and on the other at least one sensor and which delimit an opening for positioning the control member in the circumferential direction. A configuration of this type is characterized by a particularly simple assembly, since it is only required to place the two yoke arcs with the first ends on the magnetic north or the magnetic south and then insert at least one sensor between the respectively other ends of the yoke arcs. Thereafter, the control member can be inserted in the opening defined by the yoke arcs in the circumferential direction.

The opening for receiving the control member preferably has a circular configuration. It has proven particularly advantageous if the opening expands radially in the direction of at least one sensor. The control member can be positioned in the opening. Positioning the control member relative to the sensor exercises a strong influence on the control signal provided by the sensor. If this direct influence exercised by the positioning of the control member is supposed to be avoided, it is advantageous if the opening comprises

an expanded area in the region of the sensor. Such an expanded area ensures that changes in the distance between the control member and the sensor, as those occurring unavoidably due to mounting tolerances of the control member, have only little influence of the control signal provided by the sensor.

As already explained above, it may be provided according to the invention that the width of the gap abutting the control member can be varied by rotating the control member. To this end it has proven particularly beneficial if the width of the gap can be varied by rotating the control member about its axis of rotation, which is aligned substantially perpendicular to the magnetic field lines permeating the gap.

Alternatively and/or additionally, it is advantageous if the width of the gap can be varied by displacing the control member along an axis of displacement, which is aligned substantially perpendicular to the magnetic field lines permeating the gap. It is particularly advantageous if the control member is displaceable substantially perpendicular to the plane that is defined by the magnetic field lines permeating the sensor. It is particularly beneficial if the control member has a rotationally symmetrical design in relation to the axis of displacement since this way it can be ensured that only a translatory movement of the control member along the axis of displacement results in a change of the control signal provided by the sensor, however a rotation of the control member about the axis of displacement does not. The demands placed on the mounting

of the control member can therefore be lowered significantly. It may be provided, for example, that the control member can be screwed in a corresponding retaining part, for example by means of a thread, however the sensor device capturing only the translatory movement of the control member along the axis of displacement, which movement occurs when it is screwed in, while the rotatory movement occurring at the same time has no influence on the control signal.

A configuration of the inventive sensor device in which the control member is expanded in a conical shape in the direction of the axis of displacement has proven particularly advantageous.

In a particularly preferred embodiment it is provided that the sensor device comprises a guide sleeve receiving the control member, which sleeve is made of a substantially nonmagnetic material. The guide sleeve enables particularly simple mounting in terms of design of the control member and can be made for example of an aluminum material, which has practically no influence on the magnetic field acting upon the control member and the sensor.

The guide sleeve is fastened, preferably together with the control member, to a guide component that is held displaceably relative to the magnet and the sensor. The latter can be configured, for example, as a guide piston, which is held displaceably in a

receiving part, particularly in a guide cylinder.

In order to couple the control member to one of the parts displaceable relative to each other, the relative position of which parts the sensor device is supposed to be capture, it is advantageous if the sensor device comprises a coupling element that is mounted to the control member. The coupling element can be configured as a ram, for example. In the case of a control member that is mounted displaceably it has proven particularly advantageous if the coupling element is mounted pivotably on the control member transversely to the direction of displacement of the control member. It may be provided for example that the coupling element is fastened to the control member by means of a spherical head. A configuration of this type has the advantage that the sensor device only detects a translatory movement of the coupling element, while a swivel movement, which occurs at the same time for example due to mounting tolerances, has no influence on the control signal provided by the sensor.

In order to avoid that the coupling element is exposed to the magnetic field generated by the magnet, it is advantageous if the control member comprises a coupling support, in which the coupling element is inserted. The magnetically conductive control member encompassing the coupling element in the circumferential direction hereby forms a magnetic shield for the coupling element.

It has proven to be particularly advantageous if the coupling support is expanded in a conical shape in the direction of the free end of the coupling element facing away from the control member, since this offers the possibility of mounting the magnetically shielded coupling element pivotably on the control member transversely to the longitudinal direction of the coupling support. It may be provided for example that the control member is configured as a conical sleeve comprising an inner cone, into which the coupling element is introduced.

The design of the magnet used according to the invention has so far not been explained in detail. As described above, the only demand that is placed on the magnet is to produce a magnetic field that can be influenced by the control member. In doing so, an electromagnet may be used, however it has proven particularly advantageous if a permanent magnet is used.

Particularly a Hall sensor can be used as the magnetic field-sensitive sensor. It is advantageous if the Hall sensor is coupled to a digital interface or a pulse width modulation (PWM) interface. To this end, it has proven to be particularly advantageous if the Hall sensor is integrated in an electronic circuit; the Hall sensor is preferably part of a user-specific micro-electronic circuit. It is particularly suitable if the user-specific micro-electronic circuit is arranged on a printed circuit board, which encompasses the

control member in the circumferential direction.

Particularly when using the sensor device in safety-relevant applications, for example a motor vehicle, it is advantageous if the sensor device comprises at least two, preferably analog, Hall sensors. Should one of the two Hall sensors fail while operating the sensor device, the second Hall sensor continues to reliably provide the desired control signal.

Alternatively and/or additionally, it may be provided that the sensor device comprises a digital Hall sensors. Hall sensors of this type are characterized by signal processing properties that are not particularly sensitive to interference.

It is particularly advantageous if the sensor device comprises a magnetic-field sensitive sensor with a quiescent current of less than 100 μA. This offers the possibility of using the sensor device as a low-current switch, which detects a relative movement between the control member and the sensor and consequently activates a control circuit arranged downstream, which in turn provides a supply voltage for at least one additionally employed, preferably analog, Hall sensor, with the help of which the absolute position of the control member relative to the additional Hall sensor can be determined. The sensor having a quiescent current of less than about 100 μA therefore assumes sort of a "wake-up function" in that it only captures a change in position of the control member, while one or more additional Hall sensors carry out the absolute

measurement. A "wake-up sensor" of this type may be particularly a digital Hall sensor having a quiescent current in the range of about 30 μA to about 100 μA.

According to the invention it may be provided that the sensor device comprises a circular housing, which receives a circular yoke comprising a magnet attached thereto as well as a printed circuit board comprising at least one Hall sensor and which contains the control member.

The invention will be explained in more detail hereinafter with reference to the embodiments that are illustrated in the figures, wherein:

Figure 1: is a longitudinal sectional view of a sensor device according to the invention used in a motor vehicle component;

Figure 2: is a representative illustration of how a control member and a yoke interact to form an air gap in the sensor device according to the invention;

Figure 3: is an exploded view of the sensor device with the control member removed;

Figure 4: is a schematic illustration of the course of the field line for a first yoke embodiment;

Figure 5: is a schematic illustration of the course of the field line for a second yoke embodiment, and

Figure 6: is an illustration of the magnetic field strength present at the sensor as a function of a selected gap width.

In the figures a sensor device that been assigned overall the reference numeral 10 is shown, which is inserted in a connector 12 of a cylinder 14 of a motor vehicle and is coupled to a bearing fork 18 of the motor vehicle by means of a ram 16. The bearing fork 18 and the connector 12 form first and second motor vehicle components, the relative positions of which can be detected by means of the sensor device 10.

The sensor device 10 comprises a housing 20 made of plastic with a housing pan 22 and a housing cover 24. The housing pan 22 accommodates a substantially circular printed circuit board 26 with electrical connections 28 as well as substantially circular magnetically conductive yoke 30. A plug shaft 32, which is likewise made of plastic, is integrally formed laterally on the housing 20 and comprises a socket 34 on the free end

facing away from the housing 20, which socket comprises electrical connecting contacts 35, which are electrically connected to the electrical connections 28 of the circuit board 26 via connecting lines that are known per se and are not illustrated in the figures.

The circuit board 26 comprises two analog Hall sensors 36, 37 and one digital Hall sensor 38, which are diametrically opposed on the circular circuit board 26 and which are connected to the electrical connections 28 via tracks disposed on the circuit board 26, which are known per se and not illustrated in the figures.

The yoke 30 comprises – as is clarified particularly in Figure 4 – two yoke arcs 40, 41 configured as semi circles, the free ends of which are bifurcated, respectively, and which receive between them on one hand the two analog Hall sensors 36 and 37 and on the other hand the digital Hall sensor 38 as well as a permanent magnet 43. The yoke 30 therefore forms a support 45 in the area of the permanent magnet 43 and an open space in the area of the analog and digital Hall sensors 36, 37 and 38, respectively, into which space the Hall sensors 36, 37 and/or 38 are inserted.

The yoke 30 is illustrated in a first embodiment in Figure 4. It is characterized in that the two yoke arcs 40, 41 delimit a substantially circular opening 50 in the circumferential direction. Figure 5 illustrates an alternative embodiment in the form of a yoke 30a. This alternative embodiment 30a likewise comprises two semi-circular yoke arcs 40a and

41a, which receive between them the Hall sensors 36, 37 and 38 as well as the permanent magnet 43 and encompass an opening 50a in the circumferential direction. The yoke 30a differs from the yoke 30 only in terms of the shape of the opening 50a, which differs from the opening 50 in that it comprises additional radial expansion areas in the regions of the Hall sensors 36, 37 and 38. The significance of these radial expansion areas 51, 52 will be addressed in more detail hereinafter.

The sensor device 10 additionally comprises a control member configured as a conical sleeve 55, comprising a conical outside 56 and a likewise conical inside 57. The guide sleeve 59 encompasses the conical sleeve 55 across the entire length. Said guide sleeve is not illustrated in Figures 4 and 5 to provide a better overview.

The guide sleeve 59, just as the conical sleeve 55, is attached with a first end to a guide piston 61, which is mounted displaceably in the cylinder 14. In order to guide the guide sleeve and the conical sleeve 55 attached thereto on the other end, a bearing sleeve 63 encompassing the guide sleeve 59 is mounted in the area of the connector 12.

As is illustrated particularly in Figure 2, the conical sleeve 55 and the guide sleeve 59 pass through the opening 50 encompassed by the yoke 30. The outer diameter of the conical sleeve 55 is selected smaller than the diameter of the opening 50, so that an air gap develops between the outside 56 of the conical sleeve 55 and the yoke 30 both in

the region of the yoke arc 40 and in the region of the yoke arc 41, respectively, the width b of which gap is dependent upon the position of the conical sleeve 55 relative to the yoke 30 due to the conical configuration of the outside 56 of the conical sleeve 55. By displacing the conical sleeve 55 along the longitudinal axis 67, i.e. perpendicular to the plane defined by the yoke 30 and consequently also by the magnetic field lines permeating the Hall sensors 36, 37 and 38, the width b of the air gap 65 is continuously varied.

The guide sleeve 59 is made of substantially nonmagnetic material, namely aluminum, while the conical sleeve 55 is made of magnetically conductive material, namely an iron material. The conical sleeve 55 is preferably made of a constructional steel, for example of St 37 constructional steel.

As is illustrated particularly in Figures 4 and 5, the magnetic field lines 69 originating from the permanent magnet 43 are bundled by the yoke 30 and/or 30a, which is likewise made of a magnetically conductive iron material, and run in the plane defined by the yoke 30 and/or 30a, which plane is aligned perpendicular to the longitudinal axis 67. A portion of the field lines originating from the permanent magnet 43 permeate the open spaces 46, 47 and 48, as a result of which they are captured by the Hall sensors 36, 37 and/or 38, while these field lines in addition extend within the yoke 30 and/or 30a. Another part of the magnetic field lines 69 extends through the air gap 65 defined

on one hand by the yoke arcs 40 and/or 41 and on the other hand by the conical sleeve 55. This part therefore bypasses the open spaces 46, 47 and 48 and therefore also the Hall sensors 36, 37 and 38 and instead permeates the magnetically conductive conical sleeve 55. Positioning of the conical sleeve 55 inside the opening 50 therefore results in a weakening of the magnetic field acting upon the Hall sensors 36, 37 and/or 38. The smaller the gap width b, the more the magnetic field present at the sites of the Hall sensors 36, 37 or 38 is impaired. As the outside 56 of the conical sleeve 55 increasingly approaches the yoke arcs 40 and/or 41, the influence of the magnetically conductive conical sleeve 55 increases. The dependency of the magnetic field present at the sites of the Hall sensors 36, 37 and/or 38 from the positioning of the conical sleeve 55 is illustrated schematically in Figure 6 using the Hall sensor 36 as an example. Figure 6 shows the magnetic field strength present at the site of the Hall sensor 36 as a function of the gap width b. It becomes apparent that the prevailing magnetic field strength increases as the gap width b increases. If the conical sleeve 55 is displaced in a direction towards the cylinder 14 along the longitudinal axis 67, i.e. perpendicularly to the plane defined by the yoke 30, it reduces the gap width b, it results in a weakening of the magnetic field strength present at the site of the Hall sensor 36. A corresponding weakening develops at the sites of the Hall sensor 37 as well as of the Hall sensor 38. The respectively present magnetic field strength is captured by the Hall sensors 36, 37 and 38, which thereupon provide a control signal reflecting the dependency of the magnetic field strength from the gap width b, which signal can be obtained by means of

the socket 34.

In order to reduce the influence on the magnetic field strength present at the sites of the Hall sensors 36, 37, 38 as a result of an unintentional movement of the conical sleeve 55 transversely to the longitudinal axis 67, the afore-mentioned expansion areas 51, 52 are incorporated on the yoke 30a in the regions of the Hall sensors 36, 37. It was found that a radial movement of the conical sleeve 55 transversely to the connecting line of the Hall sensors 36, 37, 38 has practically no influence on the magnetic field strength present at the sites of the Hall sensors 36, 37, 38 and hence on the control signal provided by the sensor. This is due to the fact that for example an increase in the air gap towards the yoke arc 40 or 40a is coupled with a decrease in the air gap towards the yoke arc 41 and/or 41a, so that overall no significant change occurs to the influence of the conical sleeve 55. Contrary to this, however, a radial movement of the conical sleeve 55 in the direction of the connecting line of the Hall sensors 36, 37, 38 results at the yoke 30 in a change of the magnetic field strength present at the sites of the Hall sensors 36, 37, 38 and hence to a change in the provided control signal. In order to minimize this influence it has proven advantageous to expand the opening 50 radially near the Hall sensors 36, 37 and 38, corresponding to the configuration of the yoke 30a. A configuration of this type has the advantage that radial movements of the conical sleeve 55, which are practically unavoidable due to mounting tolerances, exert practically no influence on the control signals provided by the Hall sensors 36, 37, 38.

The course of the respectively provided control signal is dependent upon the shape of the outside 56 of the conical sleeve 55. In the illustrated example, the outside 56 has a conical design, which in turn results in a change of the magnetic field strength present at the sites of the Hall sensors 36, 37 and 38, in accordance with the exponential progression shown in Figure 6. Alternatively the outside 56 could also be configured in a stepped design. This would mean that the gap width b changes abruptly as soon as corresponding step of the outside 56 is positioned near the yoke 30. The control signals provided by the Hall sensors 36, 37 and 38 can therefore be defined by selecting the corresponding surface configuration of the outside 56.

The sensor device 10 in the illustrated example is configured as a linear sensor, with the help of which the position of the displaceable conical sleeve 55 can be detected, which in the illustrated example has a rotationally symmetrical design. Alternatively, the sensor device 10 could also be used as an angle rotation sensor. For this it would only be required to configure the conical sleeve 55 asymmetrically in relation to a rotation about the longitudinal axis 67, so that the width b of the air gap 65, which is defined on one hand by the yoke arcs 40 and/or 41 and on the other hand by the conical sleeve 55, can be varied by rotating the conical sleeve 55 about the longitudinal axis 67.

The conical sleeve 55 is coupled to the bearing fork 18 by means of a ram 16, as explained above. The inside 57 of the conical sleeve 55 in this case defines a ram support 71, into which the ram 16 is introduced, which has a spherical head 63 on the end facing the cylinder 14. The ram 16 is mounted pivotably in the conical sleeve 55 transversely to the longitudinal axis 67 by means of the spherical head 63. This way it is ensured that a swivel motion upon actuation of the sensor device 10, which occurs unavoidably due to the mounting tolerances of the bearing fork 18, has practically no influence on the displacement movement of the conical sleeve 55.

By using the sensor device 10, the relative position between the bearing fork 18 and the connector 12 can be captured reliably and reproducibly, wherein due to the use of the yoke 30 practically no magnetic interference fields are produced and external magnetic fields have only very little influence on the control signal provided by the Hall sensors 36, 37 and 38. The range of movement of the bearing fork 18 that the sensor device 10 can detect is only limited by the shape of the outside 56 of the conical sleeve 55, without placing particular linearity demands on the employed permanent magnet 43 or the mount thereof relative to the Hall sensors 36, 37 and 38.

The digital Hall sensor 38 used in the illustrated sensor device 10 has a quiescent current of about 50 μA to about 100 μA. This offers the possibility of supplying it continuously with power, without resulting in significant energy consumption of the power source that is used, for example a battery. The two analog Hall sensors 36, 37 have a higher quiescent current and are therefore only electrically connected to the power supply when the digital Hall sensor 38 has detected a relative movement of the conical sleeve 55. The Hall sensor 38 therefore assumes a “wake-up function” for the sensor device 10. This enables continuous monitoring of the position of the conical sleeve 55 and of the movable part coupled thereto, without being associated with notable power consumption.

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CLAIMS

1. A sensor device for producing an electric control signal that is dependent upon the relative position of two parts movable relative to each other, particularly two motor vehicle components, which device comprises at least one magnet for producing a magnetic field and at least one magnetic field-sensitive sensor, which provides an electrical control signal as a function of the strength of the magnetic field acting upon it, characterized in that the magnet (43) and the sensor (36, 37, 38) are held in a stationary manner relative to each other and in that the sensor device (10) comprises a magnetically conductive control member (55), which is held displaceably in relation to the magnet (43) and the sensor (36, 37, 38) for the purpose of influencing the magnetic field acting upon the sensor (36, 37, 38) as a function of the relative position of the control member (55).

2. A sensor device according to claim 1, characterized in that the control member (55) can be positioned in series with the sensor (36, 37, 38) in relation to the magnetic field lines (69) originating from the magnet (43).

3. A sensor device according to claim 1, characterized in that the control member (55) can be positioned parallel to the sensor (36, 37, 38) in relation to the magnetic field lines (69) originating from the magnet (43).

4. A sensor device according to any one of the above claims, characterized in that the control member (55) abuts a gap (65) permeated by magnetic field lines (69), the width (b) of which gap can be varied by moving the control member (55).

5. A sensor device according to claim 4, characterized in that the gap width (b) can be varied continuously.

6. A sensor device according to any one of the above claims, characterized in that the course of the control signal corresponding to the movement of the control member (55) is defined by the design of the surface (56) of the control member (55).

7. A sensor device according to any one of the above claims, characterized in that the sensor device (10) comprises a magnetically conductive yoke (30) for the purpose of bundling the magnetic field, which yoke is disposed adjacent to the magnet (43) and defines an open space (46, 47 and 48), in which at least one sensor (36, 37, 38) is disposed.

8. A sensor device according to claim 7, characterized in that the yoke (30) forms a support (45), in which the magnet (43) is positioned.

9. A sensor device according to claim 8, characterized in that the yoke (30) has a circular shape and that the support (45) and the open spaces (46, 47, 48) are diametrically opposed.

10. A sensor device according to claim 7, 8 or 9, characterized in that the yoke (30) comprises two yoke arcs (40, 41), which are configured as semi circles, receive between them on the ends on one hand the magnet (43) and on the other hand at least one sensor (36, 37, 38) and delimit an opening (50) for positioning the control member (55) in the circumferential direction.

11. A device according to claim 10, characterized in that the opening (50) has a substantially circular configuration.

12. A sensor device according to claim 10 or 11, characterized in that the opening (50) expands radially in the direction of at least one sensor (36, 37, 38).

13. A sensor device according to any one of the claims 4 to 12, characterized in that the width (b) of the gap (65) can be varied by rotating the control member (55)

about an axis of rotation that is aligned perpendicular to the magnetic field lines permeating the gap (65).

14. A sensor device according to any one of the claims 4 to 13, characterized in that the width (b) of the gap (65) can be varied by displacing the control member (55) along an axis of displacement (67) that is aligned perpendicular to the magnetic field lines permeating the gap (65).

15. A sensor device according to claim 14, according to claim the control member (55) has a rotationally symmetrical configuration in relation to the axis of displacement (67).

16. A sensor device according to claim 14 or 15, characterized in that the control member (55) expands conically in the direction of the axis of displacement (67).

17. A sensor device according to any one of the above claims, characterized in that the sensor device (10) comprises a guide sleeve (59), which receives the control member (55) and is made of substantially nonmagnetic material.

18. A sensor device according to claim 17, characterized in that the guide sleeve (59) and the control member (55) are attached to a guide component (61), which is held displaceably relative to the magnet (43) and the sensor (36, 37, 38).

19. A sensor device according to claim 18, characterized in that the guide component (61) is held displaceably in a guide support (14).

20. A sensor device according to any one of the above claims, characterized in that the sensor device (10) comprises a coupling element (16) mounted to the control member (55) for the purpose of coupling the sensor device (10) to one of the two parts (18) can be displaced relative to each other.

21. A sensor device according to claim 20, characterized in that the coupling element is configured as a ram (16).

22. A sensor device according to claim 20 or 21, characterized in that the control member (55) can be displaced and that the coupling element (16) is mounted pivotably on the control member (55) transversely to the direction of displacement (67) of the control member (55).

23. A sensor device according to claim 20, 21 or 2 [sic], characterized in that the control member (55) comprises a coupling support (71), in which the coupling element (16) is introduced.

24. A sensor device according to claim 23, characterized in that the control member (55) is configured as a conical sleeve (55) comprising an inner cone (71), in which the coupling element (16) is introduced.

25. A sensor device according to any one of the claims 20 to 24, characterized in that the coupling element (16) is fastened to the control member (55) by means of a spherical head (73).

26. A sensor device according to any one of the above claims, characterized in that at least one sensor is configured as a Hall sensor (36, 37, 38).

27. A sensor device according to claim 26, characterized in that the sensor device (10) comprises at least two analog Hall sensors (36, 37).

28. A sensor device according to any one of the above claims, characterized in that the sensor device (10) comprises a magnetic field-sensitive sensor with a quiescent current of less than about 100 μA.

29. A sensor device according to claim 26, 27 or 28, characterized in that the sensor device (10) comprises at least one digital Hall sensors (38).

30. A sensor device according to any one of the claims 26 to 29, characterized in that the Hall sensor (36, 37, 38) is configured as part of a user-specific micro-electronic circuit.

31. A sensor device according to any one of the above claims, characterized in that the magnet is configured as a permanent magnet (43).

32. A sensor device according to any one of the above claims, characterized in that the sensor device (10) comprises a circular housing (20), which accommodates a circular yoke (30) with a magnet (43) as well as a circuit board (26) with at least one Hall sensor (36, 37, 38) and which contains the control member (55).